



# LOW NOISE X-BAND GaAs MESFET

## NE21800 NE21889

### FEATURES

- **VERY HIGH f<sub>max</sub>**: 60 GHz
- **LOW NOISE FIGURE**
  - 1 dB at 4 GHz
  - 1.7 dB at 8 GHz
  - 2.8 dB at 12 GHz
- **HIGH MAXIMUM AVAILABLE GAIN**
  - 16.5 dB at 4 GHz
  - 11.5 dB at 8 GHz
  - 9.5 dB at 12 GHz
- **PROVEN RELIABILITY AND STABILITY**
- **RUGGED 1 MICRON RECESSED GATE**
- **SPACE QUALIFIED**

### DESCRIPTION AND APPLICATIONS

The NE218 is a 1 μm recessed gate gallium arsenide (GaAs) n-channel field effect transistor (FET). Offering low noise figure and high associated gain thru 8 GHz, the NE218 is ideal for 3.7 to 4.2 GHz ground station LNA applications.

The device is available as a chip (NE21800), and in a rugged hermetically sealed metal-ceramic stripline package (NE21889). The chip's gate and channel are glassivated with a thin layer of SiO<sub>2</sub> for mechanical protection only.

### PERFORMANCE SPECIFICATIONS (T<sub>A</sub> = 25°C)

PART NUMBER EIAJ <sup>1</sup> REGISTERED NUMBER PACKAGE OUTLINE			NE21800 00 (CHIP)			NE21889 2SK281 89		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX
f <sub>MAX</sub>	Maximum Frequency of Oscillation at V <sub>DS</sub> = 3 V, I <sub>DS</sub> = 30 mA	GHz		60			60	
MAG	Maximum Available Gain <sup>2</sup> at V <sub>DS</sub> = 4 V, I <sub>DS</sub> = 30 mA (Typ. I <sub>DS</sub> = 50% I <sub>DSS</sub> ) f = 4 GHz f = 8 GHz f = 12 GHz	dB dB dB		16.5 11.5 9.5			16 11 9	
NF <sub>OPT</sub>	Optimum Noise Figure <sup>3</sup> at V <sub>DS</sub> = 3 V, I <sub>DS</sub> = 10 mA (Typ. I <sub>DS</sub> = 15% I <sub>DSS</sub> ) f = 4 GHz, Γ <sub>OPT</sub> = .56∠103°, R <sub>N</sub> = .25 f = 8 GHz, Γ <sub>OPT</sub> = .31∠126°, R <sub>N</sub> = .11 f = 12 GHz	dB dB dB		1 1.7 2.8	1.2 <sup>4</sup>		1 1.7 2.8	1.2
GA	Associated Gain at Optimum Noise Figure at V <sub>DS</sub> = 3 V, I <sub>DS</sub> = 10 mA (Typ. I <sub>DS</sub> = 15% I <sub>DSS</sub> ) f = 4 GHz f = 8 GHz f = 12 GHz	dB dB dB		13 10.5 7.5		12	13 10 7	
P <sub>1dB</sub>	Output Power at 1 dB Compression Point at V <sub>DS</sub> = 4 V, I <sub>DS</sub> = 30 mA (Typ. I <sub>DS</sub> = 50% I <sub>DSS</sub> ) f = 4 GHz	mW		50			50	

**Notes:**

1. Electronic Industrial Association of Japan.
2. Gain Calculations:  $MAG = \frac{|S_{21}|}{|S_{12}|} (K \pm \sqrt{K^2 - 1})$ ,  $K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2|S_{12}||S_{21}|}$ ,  $\Delta = S_{11}S_{22} - S_{21}S_{12}$
3. Typical values of noise figures are those obtained when 50% of the devices from a large number of lots were individually measured in a circuit with the input individually tuned to obtain the minimum value. Maximum values are criteria established on the production line as a "go-no-go" screening test with the fixture tuned for the "generic" type but not for each specimen.
4. RF performance of chips is determined by packaging and testing 10 chips per wafer; wafer rejection criteria for standard devices is 2 rejects for 10 samples.



**ELECTRICAL CHARACTERISTICS** (TA = 25°C)

PART NUMBER EIAJ <sup>1</sup> REGISTERED NUMBER PACKAGE OUTLINE			NE21800 00 (CHIP)			NE21889 2SK281 83		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX
I <sub>DSS</sub>	Drain Current at V <sub>DS</sub> = 3 V, V <sub>GS</sub> = 0	mA	30	70	120	30	70	120
V <sub>P</sub>	Pinch-off Voltage at V <sub>DS</sub> = 3 V, I <sub>D</sub> = 0.1 mA	V	-0.8	-2.0	-6.0	-0.8	-2.0	-6.0
g <sub>M</sub>	Transconductance at V <sub>DS</sub> = 3 V, I <sub>D</sub> = 10 mA	mS	20	40	100	20	40	100
I <sub>GS</sub>	Gate to Source Leakage Current at V <sub>GS</sub> = -5 V	μA		1.0	10		1.0	10
R <sub>TH</sub>	Thermal Resistance (Channel-to-Ambient)	°C/W			170 <sup>2</sup>			400
P <sub>T</sub>	Total Power Dissipation	mW			500 <sup>2,3</sup>			300 <sup>4</sup>

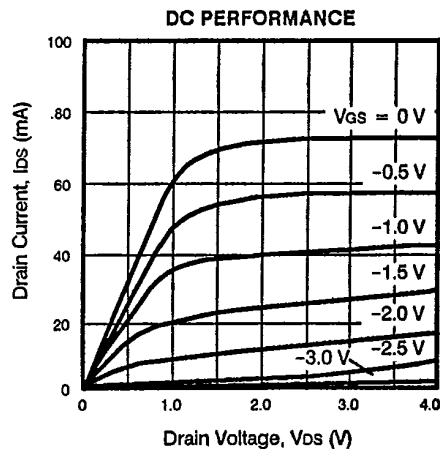
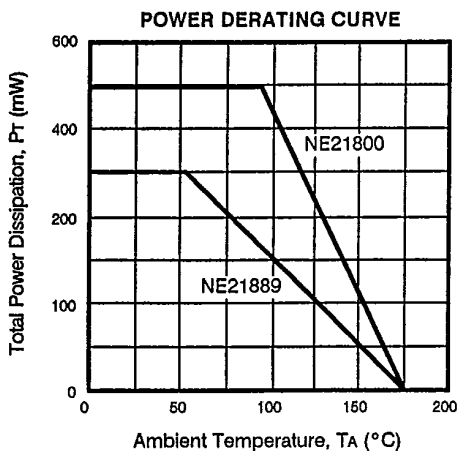
**Notes:**

1. Electronic Industrial Association of Japan.
2. R<sub>TH</sub> (channel to case) for chips mounted on a copper heatsink.
3. TA = 90°C
4. TA = 55°C

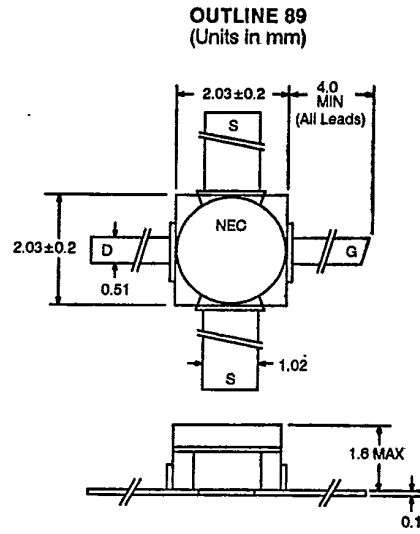
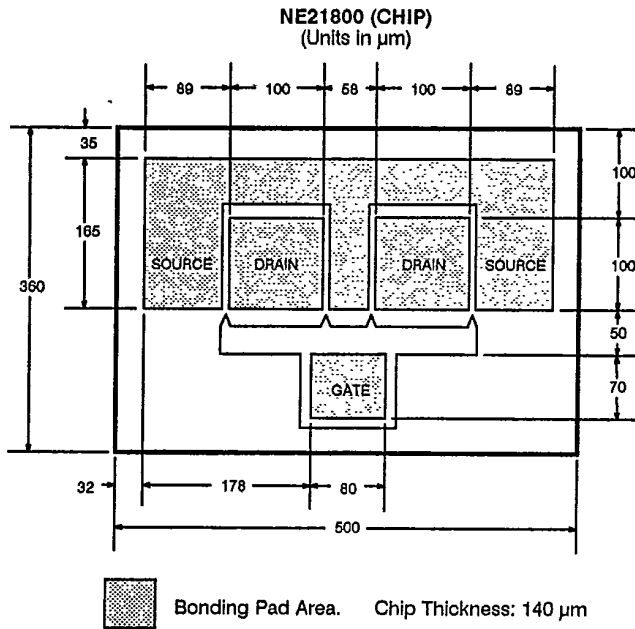
**ABSOLUTE MAXIMUM RATINGS** (TA = 25°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V <sub>DS</sub>	Drain to Source Voltage	V	5.0
V <sub>GS</sub>	Gate to Source Voltage	V	-6.0
I <sub>D</sub>	Drain Current	mA	120
P <sub>IN</sub>	RF Input Power	mW	40
T <sub>CH</sub>	Channel Temperature	°C	175
T <sub>STG</sub>	Storage Temperature	°C	-65 to +175

**TYPICAL DEVICE CHARACTERISTICS** (TA = 25°C)

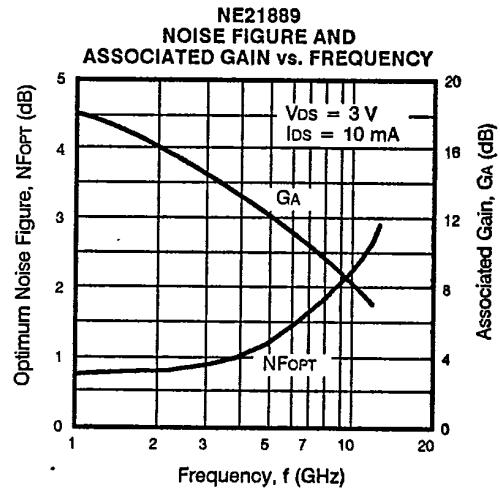
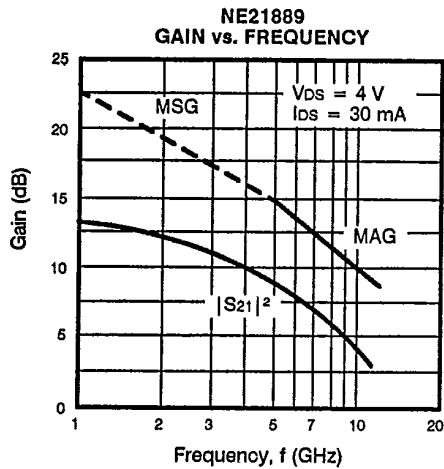


**OUTLINE DIMENSIONS**

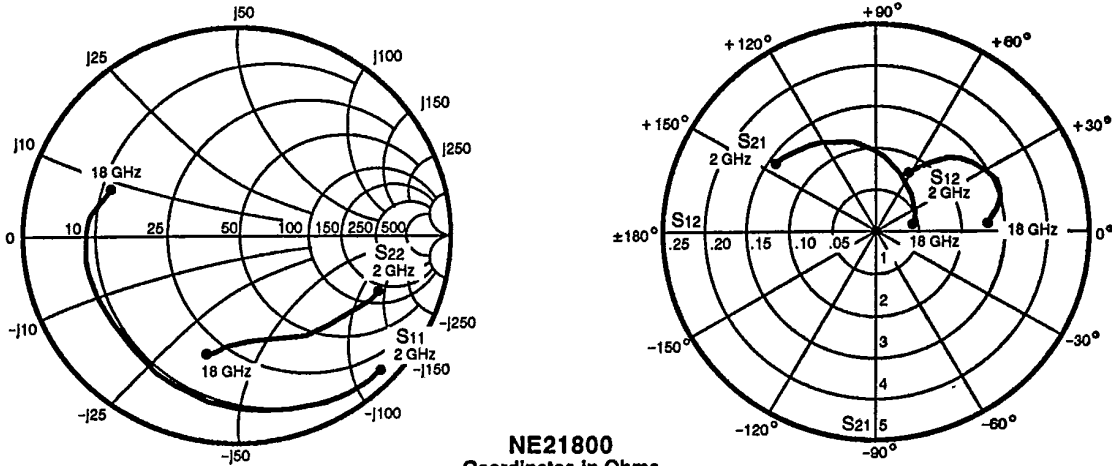


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**TYPICAL PERFORMANCE CHARACTERISTICS (TA = 25°C)**



**TYPICAL COMMON SOURCE SCATTERING PARAMETERS**



**NE21800**  
Coordinates in Ohms  
Frequency in GHz  
(V<sub>DS</sub> = 3 V, I<sub>DS</sub> = 10 mA)

**S-MAGN AND ANGLES:**

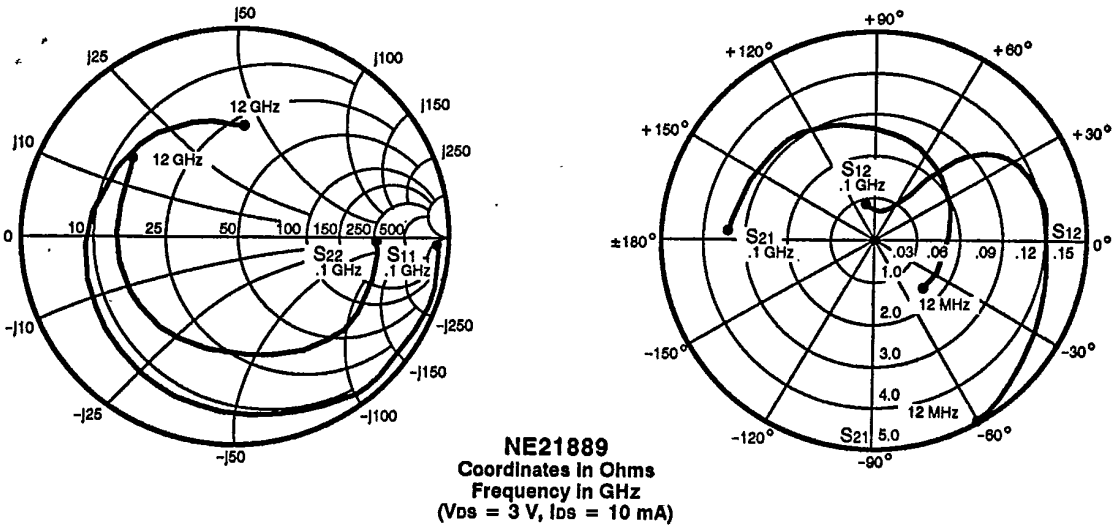
V<sub>DS</sub> = 3 V, I<sub>DS</sub> = 10 mA

FREQUENCY (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
2000	.91	-44	2.95	144	.08	64	.71	-22
3000	.90	-63	2.81	132	.11	53	.68	-27
4000	.83	-81	2.47	113	.12	44	.62	-35
5000	.78	-96	2.27	105	.14	36	.58	-43
6000	.75	-108	2.08	97	.15	32	.56	-52
7000	.70	-119	1.83	87	.15	26	.55	-58
8000	.67	-130	1.65	79	.15	19	.55	-63
9000	.66	-140	1.49	72	.15	18	.56	-65
10000	.64	-152	1.37	64	.15	15	.56	-67
11000	.64	-158	1.24	59	.14	14	.54	-66
12000	.67	-165	1.18	54	.14	13	.54	-67
13000	.69	-168	1.11	49	.14	11	.51	-74
14000	.69	-175	1.11	44	.14	12	.54	-80
15000	.65	-178	1.05	38	.13	9	.55	-86
16000	.66	174	1.02	33	.14	9	.53	-90
17000	.63	164	.96	26	.13	8	.56	-95
18000	.64	160	.86	21	.13	9	.50	-97

V<sub>DS</sub> = 3 V, I<sub>DS</sub> = 30 mA

2000	.90	-49	3.61	143	.07	62	.65	-24
3000	.89	-70	3.39	130	.10	52	.61	-28
4000	.83	-88	2.91	117	.11	44	.55	-36
5000	.78	-103	2.63	104	.12	36	.51	-44
6000	.75	-116	2.37	97	.13	33	.49	-53
7000	.70	-126	2.08	87	.13	27	.49	-59
8000	.68	-137	1.87	79	.13	22	.49	-64
9000	.67	-148	1.67	73	.13	21	.51	-67
10000	.65	-158	1.53	65	.12	19	.51	-68
11000	.65	-164	1.37	60	.12	18	.49	-67
12000	.70	-171	1.32	55	.12	18	.47	-68
13000	.72	-174	1.23	51	.12	17	.47	-75
14000	.74	-180	1.22	46	.13	20	.49	-81
15000	.67	177	1.16	40	.12	17	.50	-87
16000	.69	169	1.12	36	.12	18	.50	-90
17000	.66	158	1.05	28	.13	18	.52	-96
18000	.67	156	.94	24	.12	20	.56	-98

**TYPICAL COMMON SOURCE SCATTERING PARAMETERS**



**S-MAGN AND ANGLES:**

V<sub>DS</sub> = 3 V, I<sub>DS</sub> = 10 mA

FREQUENCY (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
100	1.00	-4	3.43	176	.02	109	.69	-2
200	1.00	-6	3.47	175	.01	77	.69	-3
500	1.00	-16	3.49	164	.01	80	.68	-9
1000	.98	-31	3.39	154	.03	73	.68	-20
2000	.92	-60	3.25	125	.06	53	.66	-39
4000	.75	-117	2.56	79	.12	15	.54	-78
6000	.67	-160	2.02	43	.11	-6	.50	-110
8000	.60	166	1.64	10	.12	-21	.50	-146
10000	.57	127	1.55	-18	.14	-38	.51	178
12000	.55	86	1.50	-52	.15	-60	.55	137

V<sub>DS</sub> = 3 V, I<sub>DS</sub> = 30 mA

100	1.00	-3	4.57	175	.01	106	.65	-3
200	1.00	-7	4.65	174	.01	81	.66	-3
500	1.00	-18	4.66	163	.01	79	.64	-8
1000	.98	-34	4.50	152	.02	70	.64	-20
2000	.89	-66	4.17	122	.05	57	.61	-37
4000	.70	-127	3.14	76	.09	19	.47	-76
6000	.60	-171	2.34	37	.10	-10	.39	-113
8000	.55	158	1.95	9	.11	-5	.46	-148
10000	.52	121	1.79	-19	.13	-25	.49	173
12000	.51	82	1.72	-53	.15	-49	.57	131

